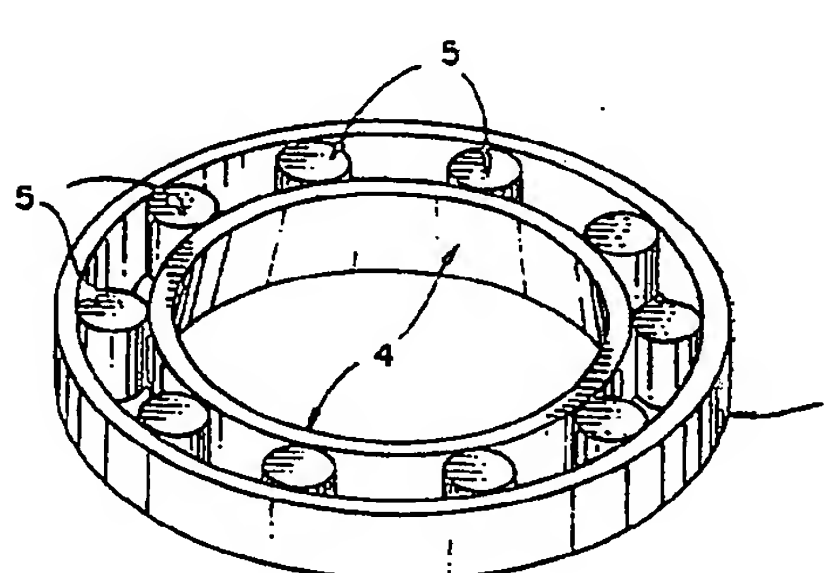
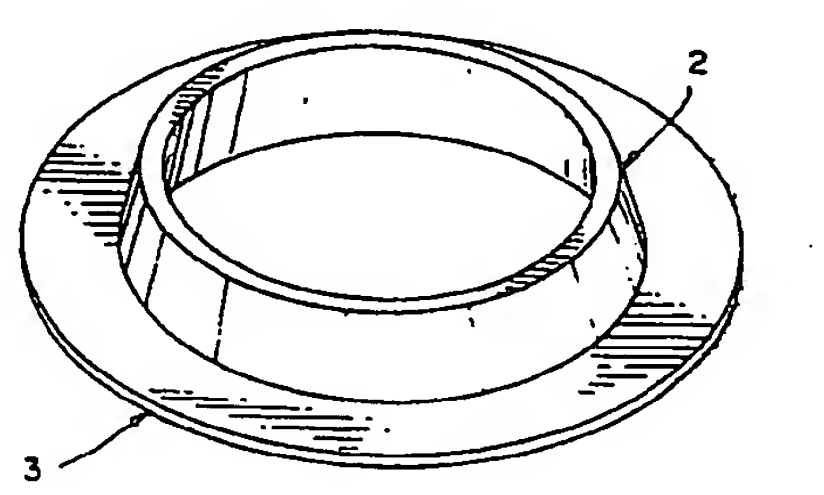




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>F16C 43/04</b>	<b>A2</b>	<b>(11) International Publication Number:</b> <b>WO 92/19878</b>  <b>(43) International Publication Date:</b> 12 November 1992 (12.11.92)
<b>(21) International Application Number:</b> PCT/US92/03302 <b>(22) International Filing Date:</b> 22 April 1992 (22.04.92)  <b>(30) Priority data:</b> 688,816                      22 April 1991 (22.04.91)                      US  <b>(71)(72) Applicant and Inventor:</b> GLAZIER, Stephen, C. [US/US]; 3202 Rowland Place, N.W., Washington, DC 20008 (US).  <b>(74) Agent:</b> McNICHOL, William; Reid & Priest, 701 Pennsylvania Avenue, N.W., Washington, DC 20004 (US).		<b>(81) Designated States:</b> AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), MC (European patent), NL (European patent), SE (European patent).  <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i>
<b>(54) Title:</b> PRESTRESSED ROLLER BEARING WITH COLLAR  <b>(57) Abstract</b>  <p>A prestressed roller bearing and method of assembly whereby the inner race, plurality of roller elements, and outer race are first assembled in an uprestressed manner. Then a tapered collar is inserted into the inner race, stretching the inner race to prestress the roller elements. This final assembly can be tested in the factory. Then the bearing is shipped and installed onto a conventional supported shaft outside of the factory, in the manner of an unprestressed bearing without special installation procedures or shafts or equipment. This provides a ready-to-mount prestressed roller bearing, factory tested and standardized, without damage from press-fit assembly of the inner race into the roller elements.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>		

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	MI	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NI	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		
ES	Spain				

PRESTRESSED ROLLER BEARING WITH COLLARField of the Invention

The present invention relates to prestressed roller bearings. More specifically, the present invention relates to  
5 a new design of prestressed roller bearing that is easily and reliably assembled in the factory in a prestressed manner without damaging the finished surfaces of the rollers or the races. After assembly, the bearing requires no special installation technique on the supported shaft, and can be  
10 purchased as a ready-to-mount bearing for a conventional shaft.

Background Art of the Invention

Prestressed roller bearings are known. See Italian Patent 418,088, issued to Steffenini, 5 February 1947, and  
15 U.S. Patent No. 3,765,071, issued to Bowen, October 16, 1973. These bearings are used to support a rotating shaft upon or within a nonrotating member, in a frictionless manner.

Common problems with conventional prestressed roller bearings are: (1) finding a method of assembly and  
20 prestressing that does not damage the rollers and races, some of which parts have polished high precision surfaces, and (2) special talent or training is required on the part of the installation mechanic in the field that installs such bearings on the supported shaft.

25 Prestressed roller bearings are commonly assembled by placing the rollers inside the outer race, and then using extreme the inner race within the rollers. This force fit of the inner race prestresses the rollers but also causes an axial sliding of the surfaces of the inner race across the

surfaces of the rollers. This is destructive to the rollers and races at the point of contact. This yields a bearing that has been weakened in an unknown and individually varying, nonstandard manner. To a certain extent, this  
5 destruction can be mitigated by rotating the inner race as it is pressed between the rollers. However, this is a difficult and unpredictable technique and also causes scarring of the surfaces. See U.S. Patent No. 2,594,578, issued to McNichol, April 29, 1952.

10 An alternative method of assembly of prestressed roller bearings is to first assemble the bearing in an unstressed manner. The bearing is then installed on the supported shaft by pressing it on a tapered end portion of the shaft. By forcing the bearing down over the tapered shaft, the  
15 expanding diameter of the tapered shaft stretches the diameter and circumference of the inner race to the point that it prestresses the rollers. The problem with this method is that it requires a special tapered shaft and special training and skill on the part of the individual who  
20 installs the bearing on the shaft. If the bearing is pressed too far on the shaft then the rollers are overly prestressed. If the bearing is not pressed farther enough down the shaft then the rollers are not adequately prestressed. The adequacy of the prestressing cannot be quality controlled in  
25 the factory setting, since the prestressing does not take place until the installation on the supported shaft in the field.

-3-

An effort has been made to facilitate this method of prestressing-by-installation on the shaft. See U.S. Patent No. 4,893,948, issued to Hoch, January 16, 1990. In Hoch, an assembled and as yet unprestressed bearing with an inner race  
5 with a conical bore is mounted without prestressing on a bearing seat on the supported shaft. The bearing seat is attached to the supported shaft and has a conical clamping sleeve. After installation, the clamping sleeve on the shaft is forced a calibrated distance into the inner race of the  
10 bearing, between the supported shaft and the inner race of the bearing. In this manner, the inner race of the bearing is stretched, thereby prestressing the rollers. This is a method of prestressing the rollers during or after installation upon the shaft. Again, this method requires  
15 special training on the part of the installing individual, and takes place at the point of installation, outside of the manufacturing facility for the bearing and outside of the quality control of such facility.

An alternative approach of prestressing upon  
20 installation is found in U.S. Patent No. 4,708,498, issued to Labedan and Merle, November 24, 1987. Here the bearing is manufactured in two halves that are unprestressed. At the time of installation, the two halves are assembled on the supported shaft by compression within the cavity of a outer  
25 mount that is installed around the two halves. Again this provides for prestressing upon installation on the shaft, outside of the manufacturing facility. It requires special training on the part of the installer and is beyond the

**SUBSTITUTE SHEET**

-4-

quality control of the factory. Furthermore, only certain bearing situations permit this half-and-half sort of bearing, and the design limits performance of the bearing after installation.

5. It is an object of the present invention to provide a prestressed roller bearing that is manufactured and prestressed within its manufacturing facility, and within the quality control of that facility.

10 It is a further object of the present invention to manufacturer such prestressed roller bearing and assemble it in a manner that does not provide for pressured axial sliding of the surfaces of the rollers over the surfaces of the races, so as to scar and damage the parts.

15 It is a further object of the invention to provide for a prestressed roller bearing that can be installed on a normal supported shaft by the normal methods of installing an unprestressed roller bearing, without special training or skill on any other part of the installing individual.

#### Summary of the Invention

20 The present invention is a prestressed roller bearing that consists of an outer circular race, an inner circular race, a plurality of roller elements, and a collar that is inserted within the inner race. The outer surface of the collar is tapered and the inner surface of the collar is  
25 cylindrical. The inner surface of the inner race is tapered at an angle coinciding with the angle of taper of the outer surface of the collar. The dimensions of the two races and the roller elements are such that the inner race, all of the

plurality of roller elements, and the outer race may be assembled in an unprestressed manner, that is with small clearances between these parts when assembled.

The bearing is then prestressed by the insertion of the tapered collar within the inner race. The inner race, after it is assembled inside the roller elements in the outer race, is pressed over the outer surface of the tapered collar. By such pressing, the tapered collar stretches the inner race, expanding the diameter and circumference of the inner race, thereby prestressing the roller elements.

When the inner race, the roller elements, and the outer race are assembled, they are assembled without prestressing, with clearances conventional to unprestressed roller bearings. This is done without pressure and without any pressed axial sliding of the surfaces of the inner race or the surfaces of the rollers. Hence, no scarring of the surfaces is experienced.

When the assembled inner is pressed over the tapered collar, the only pressure and scarring between the parts of the bearing are between the outer surface of the collar and the inner surface of the inner race. The roller elements and the inner and outer races are not axially slid over each other during this final prestressing assembly onto the tapered collar. The tapered collar may have a lip on the edge of its outer surface, at the end with the longest diameter, to stop the further insertion of the inner race. The dimensions of the parts of the bearing may be predesigned so that the exact required amount of prestressing of the

roller elements are obtained when the inner race is fully pressed onto the tapered collar and stopped by contact with the lip on the collar.

After assembly, the inner race and the tapered collar do not move in relation to each other. During the last prestressing step of assembly there is considerable pressure, friction, and scarring between the inner race and the tapered collar. However, during the use of the bearing, these parts are not intended to move in relation to each other, and are intended to be fixed in relationship to each other. Therefore, scarring between these two surfaces is not material to the functioning of the bearing.

The result is a prestressed roller bearing that is completely assembled and prestressed in the factory and is subject to quality control in the factory. It then may be shipped to its users and installed on a conventional cylindrical shaft to be supported by the bearing, in the manner of a conventional unprestressed bearing.

### Brief Description of the Drawings

20            Figure 1 shows a partially exploded view of the invention.

Figure 2 shows an assembled perspective view of the invention.

Figure 3 shows a cross-sectional view of the tapered  
25 collar.



Detailed Description of the Invention

Figure 1 shows the outer race 1, the plurality roller elements 5, all assembled around the inner race 4. Also shown is the tapered collar 2 with the collar lip 3.

5 Figure 2 shows the outer race 1 assembled with the plurality of roller elements 5, the inner race 4, and the tapered collar 2, with a collar lip 3.

Figure 3 shows a cross-sectional view of the tapered collar 2, with the collar lip 3. The tapered outer -surface  
10 11 of the tapered collar 2 is shown. The cylindrical inner surface 12 of the tapered collar 2 is also shown.

Although the above description discusses prestressed roller bearings, it is applicable to all prestressed bearings regardless of the nature of the roller elements. For  
15 example, it may apply to prestressed bearings with solid cylindrical roller bearings, hollow cylindrical roller bearings, tapered needle bearings (whether hollow or solid), or ball bearings (whether hollow or solid). Furthermore, the bearings can be made of any of a variety of materials,  
20 including for example, metals, metal alloys, ceramics, plastics, glasses, composite materials, and laminates. Furthermore, an outer tapered collar may be used, instead of an inner tapered collar; that is, the tapered collar may have a tapered inner bore, and a cylindrical outer surface, and be  
25 inserted over the outer race (with a tapered outer surface) to compress the outer race and thereby prestress the roller elements before installation. Also, such an outer collar can be used with an inner collar (as described in detail herein)

on the same bearing. Furthermore, the inner surface of the inner collar, which contacts the supported shaft, may have any of the conventionally used bearing inner surface configurations for contact with the supported shaft, such as  
5 smooth cylindrical, ribbed, tapped, slightly tapered, threaded, grooved, or spliced. Furthermore, different bearing configurations may be used, such as double rows of roller elements, multiple rows of roller elements, or roller elements and races for both radial and axial thrust loads.  
10 Furthermore, the bearing and method of assembly described herein can also be used to apply a predetermined radial tensioning force to the inner race to stretch it to achieve optimum clearances and play between the elements of a precision bearing, but short of prestressing the roller  
15 elements. (If the inner race is expanded a bit by a small collar, then the clearances between the roller elements and the races are reduced but not eliminated. If, instead, the inner race is expanded more by a larger collar, then these clearances are reduced to zero. If, instead, the inner race  
20 is expanded beyond this zero point by an even larger collar, then the roller elements are compressed between the inner and outer races and are thereby prestressed as described in detail herein.) All these variations and others are equivalent to the claimed invention.

25 The embodiments illustrated and discussed herein are intended only to teach those skilled in the art the best way known by the inventor to make and use the invention. Nothing in the specification should be considered as limiting the

scope of the present invention. Any changes could be made by those skilled in the art to produce equivalent devices without departing from the invention. The present invention should only be limited by the following claims and their  
5 legal equivalents.

Claims

I claim:

1. A prestressed roller bearing comprising:
  - 5 a. an outer circular race;
  - b. an inner circular race with a tapered inner surface:
  - c. a plurality of roller elements; and
  - 10 d. a tapered collar with a tapered outer surface (tapered at the same angle as the angle of taper of the inner surface of the inner race) and a cylindrical inner surface, such that (i) when the plurality of roller elements and the inner race are assembled inside the outer race, then the roller elements are not
  - 15 prestressed, but such that (ii) when this assembly is further assembled upon the outer tapered surface of the tapered collar (the tapered collar being inserted into the inner race), then the diameter of the inner race is expanded to prestress the plurality of roller elements.
2. The prestressed roller bearing of Claim 1, further comprising, a flange on the outer surface of the tapered
- 25 collar at the end with the largest diameter of such tapered outer surface.
3. A method of assembling a prestressed roller bearing comprising (i) a circular outer race, (ii) a plurality of

-11-

roller elements, (iii) a circular inner race with a tapered inner surface and (iv) a tapered collar with a flange at its end of greatest diameter and with a tapered outer surface and a cylindrical inner surface, such method comprising the steps

5 of:

a. assembling the plurality of the roller elements and the inner race inside the outer race, in an unstressed manner;

10

b. presenting such assembled inner race to the tapered collar such that the end of the inner race with the tapered inner surface with the largest diameter is presented to the end of the tapered collar with the tapered outer surface which has the smallest outer diameter;

15

and

c. pressing said assembled inner race, plurality of roller elements, and outer race onto the tapered outer surface of the tapered collar (the tapered collar being inserted into the inner race), such that the diameter of the inner race is stretched so as to prestress the plurality of roller elements.

20

4. The method of assembly of Claim 3, further comprising:

25

(a) pressing said assembled inner race, roller elements, and outer race over said tapered collar until said inner race is in contact with said collar flange.

1/2

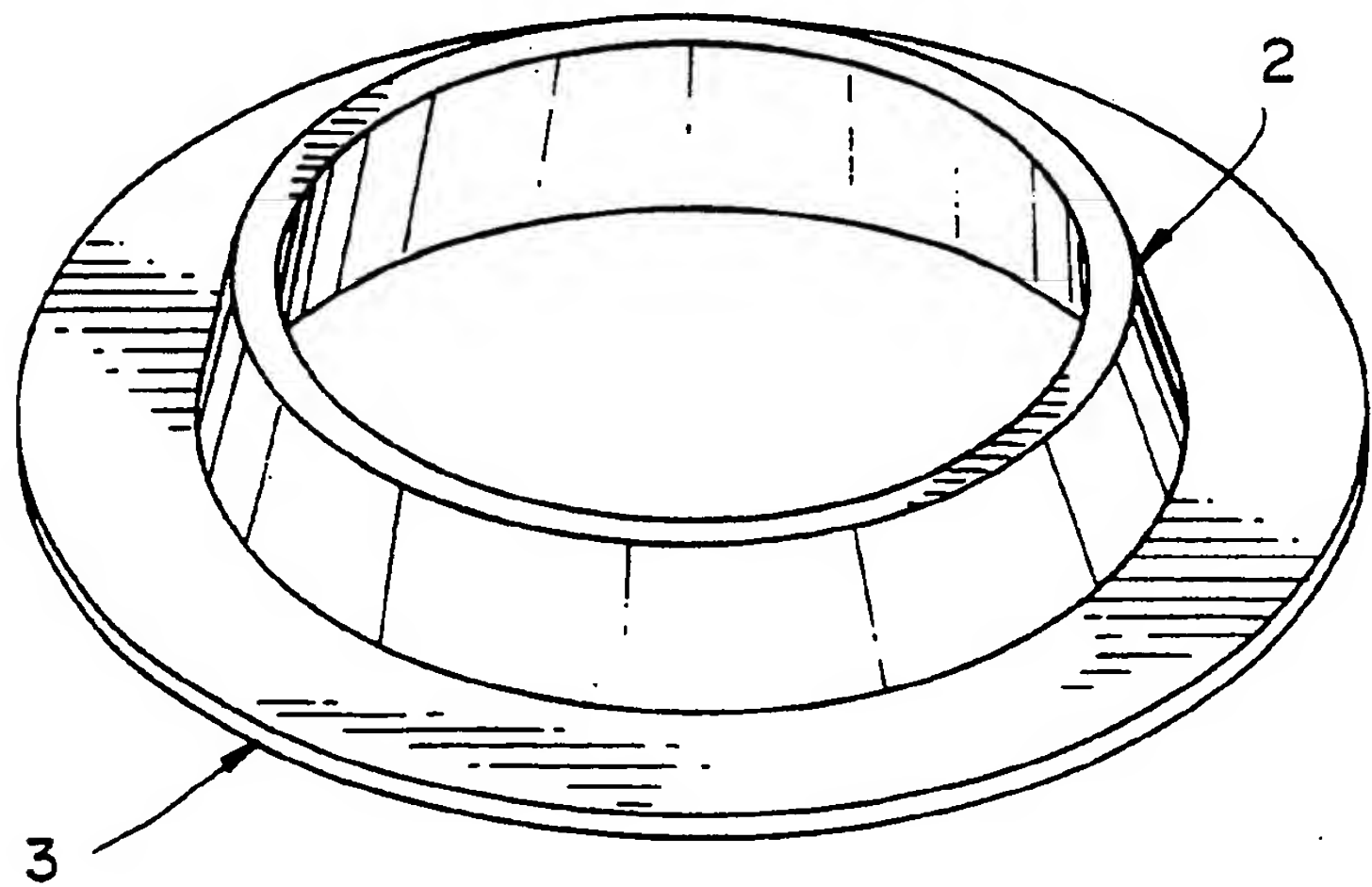
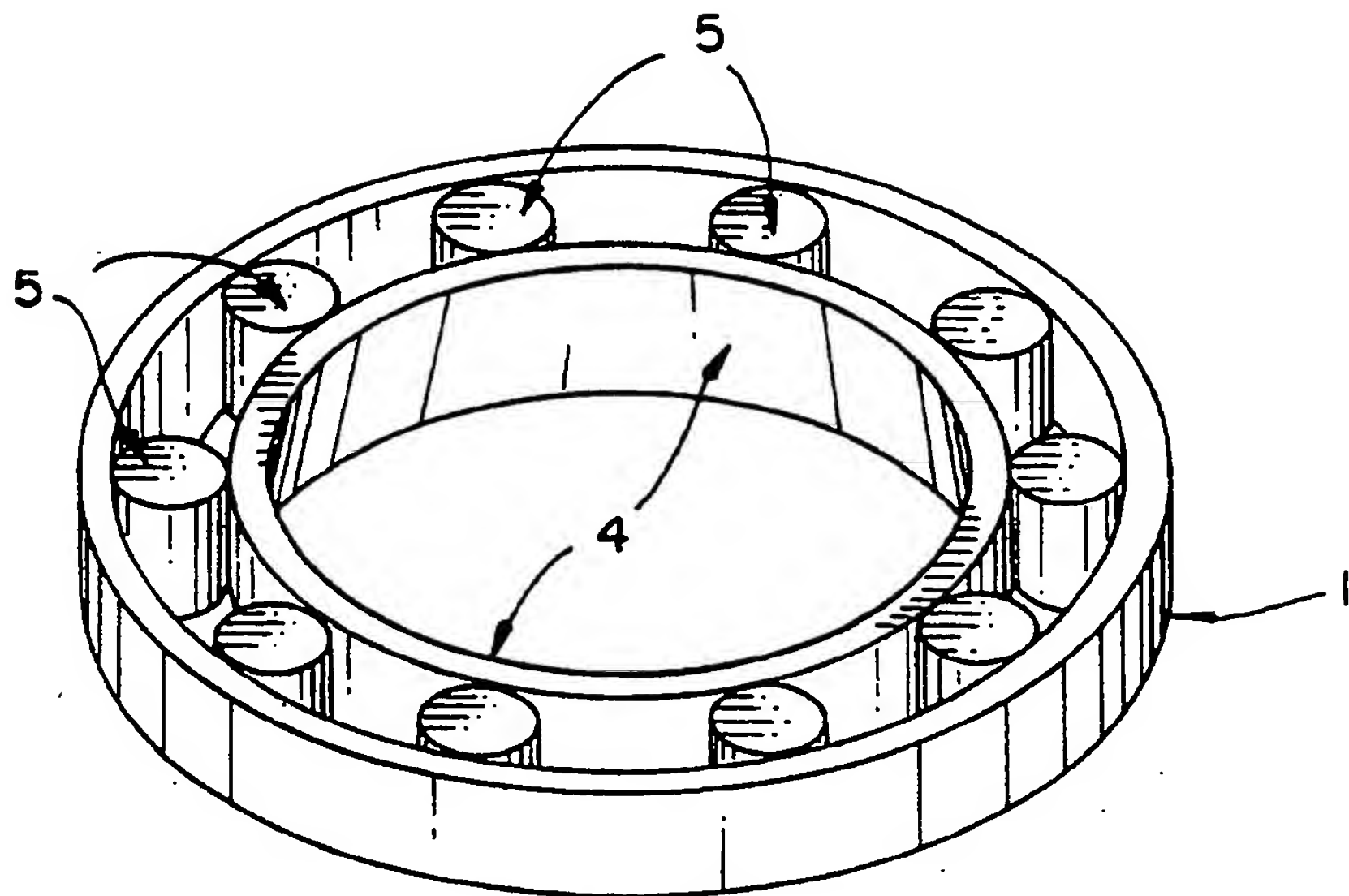


FIG. 1

SIIRSTITIIE SHEET

2/2

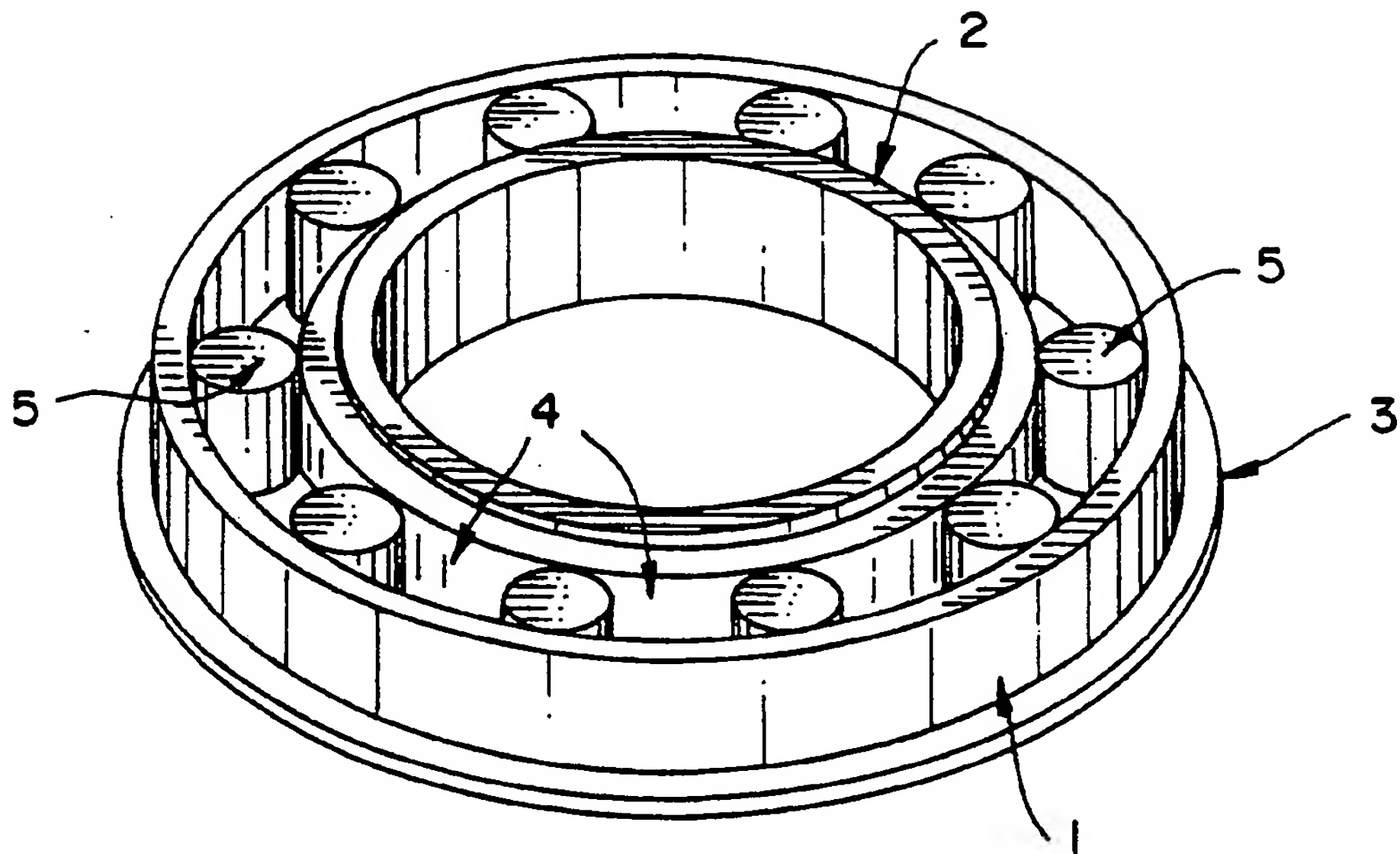


FIG. 2

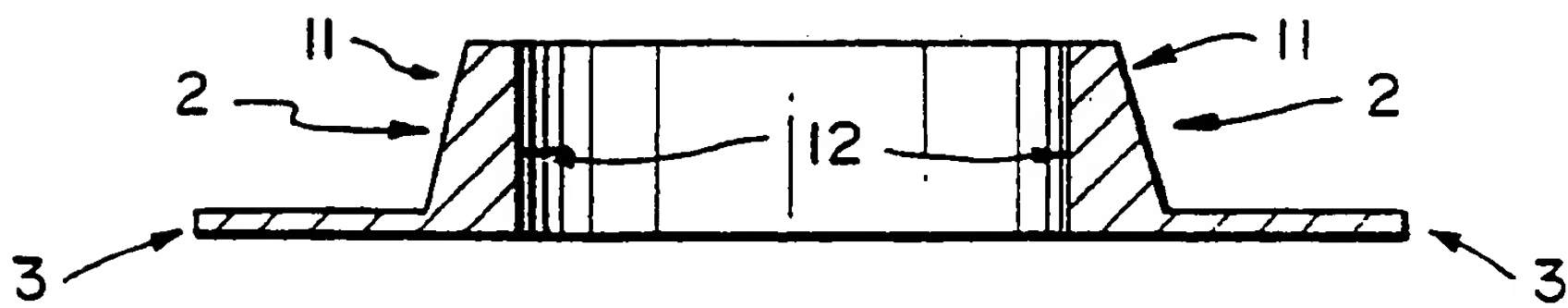


FIG. 3

SUBSTITUTE SHEET